CALCULATING MONTHLY TRITIUM RADIOACTIVE AIR EMISSIONS FROM SAMPLED STACKS AT TA-53

Purpose

This Air Quality Group procedure describes the process used to calculate and report tritium stack emissions at LANSCE (TA-53) using a silica gel system. Although tritium monitoring at LANSCE is not required to comply with NESHAP, the method described in this procedure meets the requirements of 40 CFR 61, Subparts A and H, National Emission Standards for Hazardous Air Pollutants.

Scope

This procedure applies to individuals in the Air Quality Group assigned to perform tritium emission calculations for LANSCE stacks sampled by a silica-gel system.

In this procedure

This procedure addresses the following major topics:

Hazard Control Plan

The hazard evaluation associated with this work is documented in HCP-ESH-17-Office Work.

Signatures

Prepared by: Dave Fuehne, ESH-17	Date: **8/4/99**
Prepared by: Scott Miller, Rad-NESHAP Project Leader	Date: **8/4/99**
Approved by: Terry Morgan, QA Officer	Date: **8/5/99**
Approved by: Doug Stavert, ESH-17 Group Leader	Date: **8/12/99**

General information

Attachments

This procedure has the following attachments:

Number	Attachment Title	No. of pages
1	Example of HTO spreadsheet layout	3

History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description of Changes
0	8/13/99	New document derived from 53 FMP 104-06.3.

Who requires training to this procedure?

The following personnel require training before implementing this procedure:

- Rad-NESHAP Project personnel performing all or part of this procedure
- ESH-17 LANSCE Coordinator
- Technical reviewer of results

Training method

The training method for this procedure is **on-the-job training** conducted by the preparer or a previously trained individual and is documented in accordance with the procedure for training (ESH-17-024).

General information, continued

References

The following documents are referenced in this procedure:

- 40 CFR 61, subparts A and H, "National Emission Standards for Hazardous Air Pollutants"
- ESH-17-024, "Personnel Training"
- ESH-17-119, "Evaluation of Radioactive Air Emissions From Sampled Stacks"
- ESH-17-127, "Determination of Stack Gas Velocity and Flow in Exhaust Stacks, Ducts, and Vents"
- ESH-17-602, "Tritium Sample Exchange On Monitored Stacks At TA-53"
- HCP-ESH-17-Office Work

Note

Actions specified within this procedure, unless preceded with "should" or "may," are to be considered mandatory guidance (i.e., "shall").

Calculating emissions

Description of sampling and analysis process

ESH-17 determines the amount of tritium emitted from LANSCE (TA-53) stacks by collecting water vapor from the stacks through one or more silica-gel cartridges. The water vapor is extracted from the cartridge monthly and counted by liquid scintillation for tritium by CST-9 or other qualified laboratory.

The officially reportable tritium emission values are determined through this monthly analysis.

Overview

Based on the stack and sample flow rates, the amount of tritium present in the water vapor collected in the silica-gel cartridge as determined by the analytical laboratory, the ESH-17 **LANSCE coordinator** or other qualified, trained person calculates the amount of tritium emitted from the stack into the environment using the methodology described in this procedure.

Current stack and sample flow rates

JCNNM determines the maximum pre-cycle stack flow rates for each stack and configuration (ESH-17-127). The ESH-17 **LANSCE coordinator** maintains a record of these flow data and uses the data for effluent calculations. Use the maximum stack flow rate measured by JCNNM during the time period under analysis (Q_{stack}). An online flow rate system, correlated to the JCNNM measurements, confirms the flow rates. The sample flow rate is set to 100 cc/min. Monthly tritium emissions are calculated using the reported stack and sample flows.

If silica gel cartridge becomes saturated

If the silica gel cartridge becomes saturated prior to scheduled changeover, exchange the cartridge immediately according to ESH-17-602 and submit it for analysis.

Performing calculations

Calculations referenced in this procedure are normally performed electronically using an Excel spreadsheet named “HTO.xls” or a similar name (e.g., HTO-v1-1.xls). See the README sheet in the spreadsheet file for instructions on using the spreadsheet. However, these calculations may be done by any means as long as the *methodology* is the same. If done by other means than HTO (such as manually), the analyst must sufficiently document the details of the calculation to demonstrate and allow verification that the *methodology* is the same.

Calculating emissions, continued

Calculating stack-sampler flow ratio

Calculate the ratio of stack flow to sampler flow:

$$Q_{ratio} = Q_{stack} / (Q_{sampler} * 3.53E\text{-}5)$$

Where: Q_{ratio} is the ratio of the flows

Q_{stack} is the volumetric flow rate of the stack in cfm (maximum measured by JCNNM during time period)

$Q_{sampler}$ is the sampler volumetric flow rate (100 cc/min)

3.53E-05 is the constant to convert cc/min to cfm

Calculating decay-corrected activity on cartridge

Calculate the total tritium activity collected on the silica-gel cartridge:

$$A_{tot} = A_{conc} * e^{-\lambda t} * (V/1000)$$

Where: A_{tot} is the total tritium activity in the sample in nCi

A_{conc} is the reported sample tritium activity in nCi/liter

V is the volume of water collected in the sample in cc

λ is the decay constant for tritium in the same units as t below

t is the time from the sample collection mid-point to the end of the sampling period. If the analytical result from the laboratory has NOT been decay corrected back to the end of the sampling period, t is the time from the sample collection mid-point to the end of the analysis time.

1000 is the constant to convert cc to liters

Calculating emissions, continued

Calculating emissions for sample period

Calculate the tritium emission for the sample period:

$$E = Q_{ratio} * A_{tot}$$

Where: E is the total tritium emission in nCi for the sample period

Q_{ratio} is the ratio of the flows calculated above

A_{tot} is the total tritium activity in the sample in nCi calculated above.

Humidity correction factors

From the ESH-17 Meteorology team, obtain the average absolute humidity (in grams of water per cubic meter of air) for the sampled stack air (if available) or for the TA-53 mesa.

Multiply this humidity value by the sampled air volume (sample flow x sample time) to obtain the "ideal" mass of water that should have been collected.

Compare this value with the water mass collected on the silica gel. If the "collected" value is greater than or equal to the "ideal" value, no correction is needed.

If the "collected" value is less than the "ideal" value, perform the following correction:

1. Assume the collected concentration (nanocuries per liter) is representative.
2. In the above equations: replace the collected water volume with the "ideal" volume of water that should have been collected (the value "V" in the above equations). Assume that 1 gram of water = 1 cubic centimeter of water.
3. Continue with the calculation as described above. The "new" value for emitted tritium activity will be a conservative calculation.

Calculating emissions, continued

Emission correction factors

As described in the *Estimating Missing Data* section of ESH-17-119, "Evaluation of Radioactive Air Emissions From Sampled Stacks," occasionally a sample period may be incomplete due to equipment malfunction or some other problem. In such cases, a scaling factor or emission correction factor must be developed to allow the emissions to represent an entire sample period. If an emission value has been determined to be invalid, an estimated value, or a replacement value, may be used in its place.

Documenting emissions

Documenting the calculations	The individual performing the calculations in this procedure documents the work performed (normally by printing the spreadsheet) and then forwards the documentation to a technical reviewer (trained to this procedure) for review.
Obtaining technical review of results	The **technical reviewer** checks all the documentation for accuracy and technical correctness. If any data were hand entered, the **technical reviewer** checks all of the entered data. If data were entered or uploaded electronically, the **technical reviewer** checks at least 10% of the entered data.
Forwarding results to project leader and to Records Coordinator	The **ESH-17 LANSCE coordinator** forwards the results to the Rad-NESHAP Project Leader within four weeks of completion and maintains a complete documentation package of all emissions determinations, including analysis results, flow measurements, assumptions, any other information relevant to emission calculations. Periodically forward document packages to the ESH-17 Records Coordinator.
Revising automated calculation methods	After writing or revising an automated (e.g., spreadsheet) calculation method used to calculate emissions at LANSCE, the **ESH-17 LANSCE coordinator** or a qualified, trained designee has a technical reviewer (trained to this procedure) verify the function of the method through hand calculations or other means, and documents these reviews. Comply with all ESH-17 software quality requirements that may be implemented after this procedure is approved.

Records resulting from this procedure

Records

The following records generated as a result of this procedure are to be submitted as records to the Records Coordinator **within four weeks** after emissions calculations are done:

- Datasheets generated as a result of performing this procedure, including documented technical & peer review.
- Documentation of peer review of new or revised spreadsheets or other techniques used to calculate emissions
- Documentation of any emissions correction factors, when necessary.

EXAMPLE OF HTO SPREADSHEET LAYOUT

Tritium Analysis TA-53-BLDG-3-ES-3

Stack ID	es-3	
Report Period	November-98	
Report Period START	26-Oct-98	
Report Period END	23-Nov-98	
Measured H-3 release	3.713E+05	microcuries
Humidity-Corrected	4.122E+05	microcuries
TOTAL # SAMPLES	2	

Repeat next section for each sample collected during report period

FIRST SAMPLE

Sample ID	ES3NOV98A	
Sample Description	ES-3, November 1998, 1 of 2	
Stack Flow	17,282	cfm; max for applicable time period
Sample ON date	26-Oct-98	
Sample ON time	10:30	
Sample OFF date	10-Nov-98	
Sample OFF time	23:59	
Sample concentration	4231.54	nCi/L
collected water mass	8.49	g H2O (sample)
collected water vol	8.49	cc H2O (sample)
Sample Flow	100	cc/min
Total Sample Time	15.56	days
	22409	minutes
Total Sample air vol	2.241E+06	cc air (sample)
H2O collected/air vol	3.78866E-06	cc H2O/cc air
Total Stack air vol	1.09664E+13	cc air (stack)
H2O in stack air	4.155E+07	cc H2O (stack)
	4.155E+04	L H2O (stack)
Tritium in stack air	1.758E+08	nCi
TRITIUM RELEASED	1.758E+05	microcuries

DATA ENTRY

by: _____

date: _____

DATA Q.A. CHECK

applies to this page and all subsequent pages

_____ Data entry from CST report H-3 concentration & water mass

_____ Start & Stop times from HTO Logbook, ESH-1 Field Office

_____ Stack & Sample flow rates

_____ Calculation steps

_____

signature or initials of reviewer

_____

Date

ESH-17 Humidity Analysis

stack humidity (g/m3)	4.67
sample air volume (m3)	2.241E+00
ideal: collected water (g)	10.47
actual collected water (g)	8.49
actual / ideal %	81.13%

Humidity Correction

Adjustment required?	yes, < 100% collection	Water vol emitted (cc)	5.121E+07
H-3 conc (nCi/L)	4231.54	(L)	5.121E+04
water volume (cc H2O)	10.465003	Tritium released (nCi)	2.167E+08
cc H2O / cc air	0.00000467	Corrected release (microcuries)	2.167E+05

EXAMPLE OF HTO SPREADSHEET LAYOUT, CONTINUED

SECOND SAMPLE

Sample ID	ES3NOV98B	
Sample Description	ES-3, November 1998, 2 of 2	
Stack Flow	17,282	cfm; max for applicable time period
Sample ON date	10-Nov-98	
Sample ON time	23:59	
Sample OFF date	23-Nov-98	
Sample OFF time	06:00	
Sample concentration	5391.93	nCi/L
collected water mass	7.41	g H2O (sample)
collected water vol	7.41	cc H2O (sample)
Sample Flow	100	cc/min
Total Sample Time	12.25	days
	17641	minutes
Total Sample air vol	1.764E+06	cc air (sample)
H2O collected/air vol	4.20044E-06	cc H2O/cc air
Total Stack air vol	8.63305E+12	cc air (stack)
H2O in stack air	3.626E+07	cc H2O (stack)
	3.626E+04	L H2O (stack)
Tritium in stack air	1.955E+08	nCi
TRITIUM RELEASED	1.955E+05	microcuries

ESH-17 Humidity Analysis

stack humidity (g/m3)	3.19
sample air volume (m3)	1.764E+00
ideal: collected water (g)	5.63
actual collected water (g)	7.41
actual / ideal %	131.68%

Humidity Correction

Adjustment required?	none required	Water vol emitted (cc)	3.626E+07
H-3 conc (nCi/L)	5391.93	(L)	3.626E+04
water volume (cc H2O)	7.41	Tritium released (nCi)	1.955E+08
cc H2O / cc air	4.20044E-06	Corrected release (microcuries)	1.955E+05

EXAMPLE OF HTO SPREADSHEET LAYOUT, CONTINUED

Report Section [copy to word processor template]

Stack ID	TA-53-BLDG-3-ES-3	
Report Period	Nov-98	
Report Period START	26-Oct-98	
Report Period END	23-Nov-98	
Stack Flow	17282	cfm
Sample Flow	100.0	cc/min
Total Sample air vol	4.005E+06	cc air (sample)
Total Stack air vol	1.960E+13	cc air (stack)
Number of samples	2	silica gel cartridges
net HTO concentration	4772.33	nCi/L
total H2O vol collected	15.90	cc H2O (sample)
Measured H-3 release	3.713E+05	microcuries
avg. stack conc.	1.895E-05	microcuries/L air
TRITIUM RELEASED		
Humidity-Corrected	4.122E+05	microcuries